ISSN 1061-9348, Journal of Analytical Chemistry, 2018, Vol. 73, No. 1, pp. 63–70. © Pleiades Publishing, Ltd., 2018.
Original Russian Text © G.K. Ziyatdinova, S.A. Romashkina, E.R. Ziganshina, H.C. Budnikov, 2018, published in Zhurnal Analiticheskoi Khimii, 2018, Vol. 73, No. 1, pp. 52–59.

ARTICLES

Voltammetric Determinations of Thymol on an Electrode Modified by Coimmobilized Carboxylated Multiwalled Carbon Nanotubes and Surfactants

G. K. Ziyatdinova*, S. A. Romashkina, E. R. Ziganshina, and H. C. Budnikov

Butlerov Institute of Chemistry, Kazan Federal University, Kazan, 420008 Russia

**e-mail: Ziyatdinovag@mail.ru*

Received April 7, 2017; in final form, July 3, 2017

Abstract—Thymol is oxidized at glassy carbon electrodes (GCEs) modified with coimmobilized carboxylated multiwalled carbon nanotubes (MWCNT-COOH) and surfactants of various nature in a Britton–Robinson buffer solution. The effect of the nature and concentration of surfactants in the composition of the electrode surface modifier on the amperometric response of thymol was evaluated. It was found that the best voltammetric characteristics are achieved in the case of an anionic 0.10 mM sodium dodecyl sulfate (SDS) (a decrease in oxidation potential by 50 mV and an increase in oxidation currents 2.2-fold in comparison with MWCNT-COOH/GCE). The electrooxidation of thymol at MWCNT-COOH–SDS/GCE proceeds irreversibly with the participation of one electron and one proton and is controlled by the adsorption of the analyte. The electrode response is linear in the ranges 0.500–17.0 and 17.0–150 μM of thymol with the limits of detection 0.14 μM and determination 0.48 μM. The developed method is tested on thymol-containing pharmaceutical preparations. The voltammetry data are compared with the results of an independent spectrophotometric determination.

Keywords: voltammetry, chemically modified electrodes, carbon nanotubes, surfactants, thymol, pharmaceutical analysis

DOI: 10.1134/S1061934818010148

Thymol (2-isopropyl-5-methylphenol) is a broad-spectrum biologically active substance. Its natural source is provided by plant raw materials, for example, thyme (*Thymus vulgaris*), oregano (*Origanum vulgare*), ajowan (*Trachyspermum ammi*), and others [1–3]. Thymol exhibits antimicrobial, antioxidant, analgesic, and anti-inflammatory properties, which determines its use as an active ingredient in food, medicines, and cosmetic products [4]. However, as for many other low-molecular-weight phenolic compounds, the effectiveness of thymol depends on its concentration [5]; it is necessary to control the concentration of thymol in real objects.

Thymol is an electrochemically active compound; therefore, electrochemical methods are used to determine it. This is largely due to the active development of chemically modified electrodes. A combination of chromatographic separation with electrochemical detection, in particular, coulometric [6] and amperometric [7, 8], is successfully used to analyze objects of complex composition. The known methods of the electrochemical determination of thymol are summarized in Table 1. The best performance is achieved using chemically modified electrodes. Among the modifiers of the electrode surface, carbon nanomaterials (nanotubes, graphene and its derivatives) and metal oxide nanoparticles were most widely used. Lower limits of detection are achieved by using the adsorption mode, but the duration of measurement is markedly increased in this case, and in the analysis of real objects, other components having close voltammetric characteristics can be accumulated.

It is of interest to expand further the range of modifiers, in particular, to use MWCNT-COOH and surfactants as comodifiers. This combination helps to stabilize the aqueous MWCNT-COOH suspension. On the other hand, it ensures the preconcentration of the analyte on the electrode surface because of hydrophobic interactions with surfactant molecules, which improves the performance of thymol determination.

EXPERIMENTAL

Reagents and solutions. We used thymol (99.5%), quercetin (95%), vanillin (99%), ascorbic acid (99%), gallic acid (99%), caffeic acid (98%), rosmarinic acid (98%) (all from Sigma, Germany); eugenol (99%) and chlorogenic acid (95%) (Aldrich, Germany). Other reagents were of cp grade.